IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of

ELY

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Serial No. **Unknown**

Group:

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Examiner:

For: **POSITION SENSOR**

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February 6, 2001

Assistant Commissioner for Patents
Washington, DC 20231

Sir:

PRELIMINARY AMENDMENT

Prior to calculation of the filing fee and in order to place the above identified application in better condition for examination, please amend the claims as follows:

IN THE CLAIMS

Cancel claims 1 through 41 in favor of new claims 42 through 101 as follows:

-- 42. A position detector comprising:

first and second members which are moveable relative to each other;

said first member comprising an excitation winding and at least one sensor winding;

an excitation circuit for applying a driving signal to the excitation winding; and

said second member comprising means for interacting with said windings such that, in response to a driving signal being applied to said excitation winding by said excitation circuit, there is generated in the or each sensor winding an output signal, said interacting means and said windings being arranged so that said output signal varies as a function of the relative position of the first and second members,

wherein the excitation circuit is arranged to apply a sequence of voltage pulses across said excitation winding, with the duration of said pulses being less than a decay

time constant of a current loop formed by said excitation circuit and said excitation winding.

43. A position detector comprising:

first and second members which are moveable relative to each other;

said first member comprising an excitation circuit for applying a driving signal to the excitation winding; and

said second member comprising a sensor winding electromagnetically coupled to said excitation winding, said electromagnetic coupling varying with the relative position of said first and second members such that, in response to a driving signal being applied to said excitation winding by said excitation circuit, there is generated in the sensor winding an output signal which varies as a function of said relative position,

wherein the excitation driver is arranged to apply a sequence of voltage pulses across said excitation winding, with the duration of said pulses being less than a decay time constant of a current loop formed by said excitation driver and said excitation winding.

44. A position detector according to claim 42 or claim 43, wherein the excitation circuit is fixed relative to the excitation winding.

45. A position detector according to either claim 42 or claim 43, wherein the excitation circuit is arranged to generate an excitation sequence comprising alternating positive and negative voltage pulses.

46. A position detector according to either claim 42 or claim 43, wherein the excitation circuit is arranged to generate an excitation sequence comprising alternating pairs of positive voltage pulses and negative voltage pulses.

47. A position detector according to either claim 42 or claim 43, wherein the excitation circuit is arranged to generate an excitation sequence in which the voltage pulses are separated by periods during which a reduced voltage is applied.

48. A position detector according to claim 47, wherein the excitation circuit is arranged to generate an excitation sequence in which the voltage pulses are separated by periods during which no voltage is applied.

49. A position detector according to either claim 42 or claim 43, wherein the excitation circuit is arranged to generate an excitation sequence in which the voltage pulses are separated by periods during which a reduced voltage is applied, wherein the duration of each voltage pulse is less than the duration of the periods between the voltage pulses.

50. A position detector according to either claim 42 or claim 43, wherein the excitation driver is arranged to generate an excitation sequence comprising a burst of voltage pulses comprising a first pulse, a plurality of intermediate pulses, and an end pulse, wherein the duration of each of the intermediate pulses is substantially the same and the duration of the start pulse is shorter than the duration of the intermediate pulses.

51. A position detector according to claim 50, wherein the excitation circuit is arranged such that the duration of the end pulse is shorter than the duration of the intermediate pulses.

52. A position detector according to either claim 42 or claim 43, wherein the excitation circuit is arranged to generate an excitation sequence comprising a burst of voltage pulses comprising a first pulse, a plurality of intermediate pulses, and an end pulse, wherein the duration of each of the intermediate pulses is substantially the same and the duration of the end pulse is shorter than the duration of the intermediate pulses.

53. A position detector according to either claim 42 or claim 43, wherein the excitation circuit is arranged to repeat the excitation sequence on a periodic basis.

54. A position detector according to either claim 42 or claim 43, wherein the excitation circuit comprises:

an excitation driver operable to supply the driving signal to the excitation winding; and

control means for generating a control signal defining an excitation sequence, the control means being arranged to supply the control signal to the excitation driver so that the excitation driver is operable to supply the excitation sequence as the driving signal.

55. A position detector according to claim 54, wherein the control means comprises a processor and storage means storing instructions for causing the processor to generate the control signal.

56. A position detector according to claim 54, wherein the excitation circuit comprises means for modulating the time decay constant.

57. A position detector according to claim 56, wherein the modulating means is arranged to vary a resistive loss in the current loop.

58. A position detector according to claim 57, wherein the excitation circuit is arranged such that the resistive loss in the excitation circuit is increased by the modulating means after the final excitation pulse of an excitation sequence.

59. A position detector according to claim 54, wherein the control means further comprises means for receiving set-up information from a host device, the set-up information defining parameters for use in the generation of the excitation sequence.

60. A position detector according to claim 59, wherein the excitation circuit is arranged to vary the duration of the voltage pulses in the excitation sequence in dependence on the information received via the receiving means.

61. A position detector according to claim 59, wherein the excitation circuit is arranged to vary the pulse repetition rate of the voltage pulses in the excitation sequence in dependence upon the information received via the receiving means.

62. A position detector according to claim 59, wherein the excitation circuit is arranged to repeat the excitation sequence on a periodic basis, the rate at which the excitation sequences are repeated being dependent upon the information received via the receiving means.

63. A position detector according to claim 54, wherein the control means further comprises means for receiving a signal indicative of the power supply voltage for the excitation driver, and wherein the control means is operable to vary the control signal such that the duration of the voltage pulses in the excitation sequence is varied in dependence on the indicated power supply voltage.

64. A position detector according to claim 54, further comprising means for sensing whether or not the first and second members are within a sensing range of each other,

wherein said control means is operable to cause the excitation driver to generate an excitation sequence having excitation pulses with a first duration when the sensing means senses that the first and second members are within the sensing range, and with a second duration when the sensing means senses that the first and second members are not within the sensing range, the first duration being longer than the second duration.

65. A position detector according to claim 54, wherein the excitation driver comprises switching elements implemented in MOSFET technology.

66. A position detector according to claim 65, wherein the excitation driver comprises at least one n-channel MOSFET switch and at least one p-channel MOSFET switch, the or each n-channel MOSFET switch having a lower on-resistance than the or each p-channel MOSFET switch.

67. A position detector according to claim 65, wherein the excitation circuit is arranged such that during the excitation sequence the or each n-channel MOSFET switch is switched on for a longer time than the or each p-channel MOSFET switch.

68. A position detector according to either claim 42 or claim 43, wherein the apparatus is arranged such that the time decay constant of the current loop incorporating the excitation winding is longer than twice the duration of each of the voltage pulses.

69. A position detector according to either claim 42 or claim 43 , wherein the apparatus is arranged such that the time decay constant of a current loop incorporating the excitation winding is longer than five times the duration of each of the voltage pulses.

70. A position detector comprising:

first and second members which are moveable relative to each other;

said first member comprising an excitation winding and at least one sensor winding;

an excitation circuit for applying a driving signal to the excitation winding; and

said second member comprising means for interacting with said winding such that, in response to a driving signal being applied to said excitation winding by said excitation circuit, there is generated in the sensor winding an output signal, said interacting means and said windings being arranged so that said output signal varies as a function of the relative position of the first and second members,

wherein the excitation circuit is operable to apply a sequence of voltage pulses across said excitation winding, with the duration of the first voltage pulse in the

excitation sequence being less than the duration of subsequent voltage pulses in the excitation sequence.

71. A position detector comprising:

first and second members which are moveable relative to each other;

said first member comprising an excitation winding;

an excitation circuit for applying a driving signal to the excitation winding; and

said second member comprising a sensor winding electromagnetically coupled to said excitation winding, said electromagnetic coupling varying with the relative position of said first and second members such that, in response to a driving signal being applied to said excitation winding by said excitation circuit, there is generated in the sensor winding an output signal which varies as a function of said relative position,

wherein the excitation circuit is operable to apply a sequence of voltage pulses across said excitation winding, with the duration of the first voltage pulse in the excitation sequence being less than the duration of subsequent voltage pulses in the excitation sequence.

72. A position detector comprising:

first and second members which are moveable relative to each other;

said first member comprising an excitation winding and at least one sensor winding;

an excitation circuit for applying a driving signal to the excitation winding; and

said second member comprising means for interacting with said winding such that, in response to a driving signal being applied to said excitation winding by said excitation circuit, there is generated in the sensor winding an output signal, said

interacting means and said windings being arranged so that said output signal varies as a function of the relative position of the first and second members,

wherein the excitation circuit is operable to apply a sequence of voltage pulses across said excitation winding, with the duration of the final voltage pulse being less than the duration of previous voltage pulses.

73. A position detector comprising:

first and second members which are moveable relative to each other;

said first member comprising an excitation winding;

an excitation circuit for applying a driving signal to the excitation winding; and

said second member comprising a sensor winding electromagnetically coupled to said excitation winding, said electromagnetic coupling varying with the relative position of said first and second members such that, in response to a driving signal being applied to said excitation winding by said excitation circuit, there is generated in the sensor winding an output signal which varies as a function of said relative position,

wherein the excitation circuit is operable to apply a sequence of voltage pulses across said excitation winding, with the duration of the final voltage pulse being less than the duration of previous voltage pulses.

74. A position detector comprising:

first and second members which are moveable relative to each other;

said first member comprising an excitation winding and at least one sensor winding;

an excitation circuit for applying a driving signal to the excitation winding; and

said second member comprising means for interacting with said winding such that, in response to a driving signal being applied to said excitation winding by said

excitation circuit, there is generated in the sensor winding an output signal, said interacting means and said windings being arranged so that said output signal varies as a function of the relative position of the first and second members,

wherein the excitation circuit is arranged to apply a sequence of voltage pulses across said excitation winding, and such that between excitation pulses a current loop is formed incorporating the excitation winding and wherein the position detector further comprises modulating means for modulating a decay time constant of the current loop.

75. A position detector comprising:

first and second members which are moveable relative to each other;

said first member comprising an excitation winding;

an excitation circuit for applying a driving signal to the excitation winding; and

said second member comprising a sensor winding electromagnetically coupled to said excitation winding, said electromagnetic coupling varying with the relative position of said first and second members such that, in response to a driving signal being applied to said excitation winding by said excitation circuit, there is generated in the sensor winding an output signal which varies as a function of said relative position,

wherein the excitation circuit is arranged to apply a sequence of voltage pulses across said excitation winding, and such that between excitation pulses a current loop is formed incorporating the excitation winding and wherein the position detector further comprises modulating means for modulating a decay time constant of the current loop.

76. A portable data input/output device comprising a position detector according to claim 1.

77. A device according to claim 76, wherein said device is a personal digital assistant.

78. A device according to claim 77, wherein said device is a mobile telephone.

79. A device according to claim 77, wherein said device is battery-powered.

80. A drive circuit for energising a predetermined excitation winding of a position sensor, wherein the drive circuit is operable to apply a sequence of voltage pulses across said winding, with the duration of said pulses being less than a decay time constant of a current loop formed by said drive circuit and said excitation winding.

81. A drive circuit for generating and applying pulses of electromotive force to a predetermined excitation winding of a position sensor, wherein the drive circuit is operable to apply a electromotive force having a first amplitude during said pulses and is operable to apply an electromotive force having a second amplitude lower than said first amplitude in periods between said pulses and wherein the drive circuit is operable to generate said pulses so that their duration is less than the duration of said periods between said pulses.

82. A drive circuit for generating and applying voltage pulses to an excitation winding of a position sensor, wherein the drive circuit is operable to apply pulses having a first voltage, a second lower voltage and a third voltage intermediate to said first and second voltages.

83. A position detector according to claim 55, wherein the excitation circuit comprises means for modulating the time decay constant.

84. A position detector according to claim 83, wherein the modulating means is arranged to vary a resistive loss in the current loop.

85. A position detector according to claim 84, wherein the excitation circuit is arranged such that resistive loss in the excitation circuit is increased by the modulating means after the final excitation pulse of an excitation sequence.

86. A position detector comprising:

first and second members which are movable relative to each other;

an excitation winding provided on the first member;

an excitation circuit for applying a driving signal to the excitation winding; and

at least one sensor winding provided on one of the first and second members and arranged so that, in response to the driving signal being applied to excitation winding by the excitation circuit, there is generated in the or each sensor winding an output signal that varies as a function of the relative position of the first and second members;

wherein the excitation circuit comprises a drive circuit operable to apply a potential difference across ends of said excitation winding during a first time interval and to short circuit the ends of the excitation winding in a second subsequent time interval.

87. A position detector according to claim 86, wherein the driving circuit comprises:

first and second semiconductor switches, each having first and second main electrodes and a control electrode, the control electrode being operable to receive a control signal for opening and closing the semiconductor switch;

wherein the first main electrode of the first semiconductor switch is connected to a first potential and the second main electrode of the second semiconductor switch is connected to a second potential different from the first potential;

wherein one end of the excitation winding is connected in common with the second main electrode of the first semiconductor switch and the first main electrode of the second semiconductor switch, and the other end of the excitation winding is connected to the second potential;

and wherein during the first time interval the first semiconductor switch is closed and the second semiconductor switch is open in order to apply said potential difference, and in the second interval the first semiconductor switch is open and the second semiconductor switch is closed to short circuit the ends of the excitation winding.

88. A position detector according to claim 87, wherein the respective control terminals are connected in common to an input terminal for receiving a control signal.

89. A position detector according to claim 88, wherein the first semiconductor switch is a p-channel semiconductor switch and the second semiconductor switch is an n-channel semiconductor switch.

90. A position detector according to claim 89, wherein the first and second semiconductor switches are MOSFET switches.

91. A position detector according to claim 87, wherein the first semiconductor switch has a higher resistance when closed than the resistance of the second semiconductor switch when closed.

92. A position detector according to claim 87, wherein the first potential is a supply potential and the second potential is a reference potential.

93. A position detector comprising:

first and second members which are movable relative to each other;

an excitation winding provided on the first member;

an excitation circuit for applying a driving signal to the excitation winding; and

at least one sensor winding provided on one of the first and second members such that, in response to driving signals being applied to said excitation winding by the excitation circuit, there is induced in the or each sensor winding an output signal which varies as a function of the position of the first and second members;

wherein said excitation circuit comprises a drive circuit having first and second switching amplifiers connectable between a supply potential and a reference potential and having respective input terminals for receiving respective control signals and respective output terminals to which respective ends of the excitation winding are connected;

wherein said drive circuit is operable to apply a first potential difference having a first polarity across the ends of said excitation winding when a control signal is applied to said first switching amplifier and no control signal is applied to said second switching amplifier, and is operable to apply a second potential difference having a second polarity opposite to the first polarity across the ends of said excitation winding when a

control signal is applied to said second switching amplifier and no control signal is applied to said first switching amplifier.

94. A position detector according to claim 93, wherein said drive circuit is operable to short circuit the ends of said excitation winding when no control signal is applied to both said first and second switching amplifiers.

95. A position detector according to claim 93, wherein said drive circuit is operable to short circuit the ends of said excitation winding when a control signal is applied to both said first and second switching amplifiers.

96. A position detector according to claim 93, wherein each switching amplifier comprises:

first and second semiconductor switches, each having first and second main electrodes and a control electrode; wherein the respective control terminals of the first and second semiconductor switches are connected in common to the input terminal so that the control signal is operable to open and close said semiconductor switches;

wherein the output terminal is connected in common to the second main electrode of the first semiconductor switch and the first main electrode of the second semiconductor switch;

wherein the first main electrode of the first semiconductor switch is for connection to said supply potential and the second main electrode of the second semiconductor switch is for connection to said reference potential; and

wherein the first main electrode of the first semiconductor switch is for connection to the supply potential and the second main electrode of the second semiconductor switch is for connection to the reference potential.

97. A position detector according to claim 96, wherein the first semiconductor switch is a p-channel semiconductor switch and the second semiconductor switch is an n-channel semiconductor switch.

98. A position detector according to claim 97, wherein the first and second semiconductor switches are MOSFET switches.

99. A position detector according to claim 98, wherein the first semiconductor switch has a greater resistance when closed than the resistance of the second semiconductor switch when closed.

100. A transducer for a position detector, the transducer being operable to convert an electrical drive signal into a corresponding electromagnetic signal, the transducer comprising an excitation circuit and an excitation winding,

wherein the excitation circuit comprises a drive circuit operable to apply a potential difference across ends of said excitation winding during a first time interval and, in a second subsequent time interval to short circuit the ends of the excitation winding.

101. A transducer for a position detector, the transducer being operable to convert an electrical drive signal into a corresponding electromagnetic signal, the transducer comprising an excitation circuit and an excitation winding,

wherein said excitation circuit comprises a drive circuit having first and second switching amplifiers connected between a supply potential and a reference potential and

having respective input terminals for receiving respective control signals and respective output terminals to which respective ends of said excitation winding are connected;

wherein said drive circuit is operable to apply a first potential difference having a first polarity across the ends of excitation winding when a control signal to said first switching amplifier and no control signal is applied to said second switching amplifier, and is operable to apply a second potential difference having a second polarity opposite to the first polarity across the ends of excitation winding when a control signal is applied to said second switching amplifier and no control signal is applied to said first switching amplifier. --.

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Serial No. **Unknown**

REMARKS

The above amendments are made to place the claims in a more traditional format.

Respectfully submitted,

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